

THE WEATHER OVER THE UNITED STATES ON JANUARY 26, 1950

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The meteorological phenomena in the United States on January 26 have been selected for discussion because they are unusually interesting, and because they were repeated, with little variation, several times during January 1950. The following description, while dealing in detail with the weather of January 26, may be taken to be fairly representative of the trend of events throughout the month. The outstanding features of the weather of January 26 were:

- (a) The record-breaking high temperatures in the eastern United States;
- (b) The severe cold in the north-central United States;
- (c) The heavy rains in the Ohio and lower Mississippi Valleys.

At 1830 GMT January 25 a cold front representing the forward edge of continental arctic air extended from near Detroit, Mich., southwestward to near Ardmore, Okla., thence northwestward as a stationary front through Casper, Wyo. By 1830 GMT, January 26, the cold air boundary was in the position shown in figure 1. The anticyclone centered near Omaha, Nebr., was 18 mb. higher in central pressure than it was 24 hours previously when it was located near Glasgow, Mont. This was the most intense High, as judged by the central pressure, to invade the United States in January. What caused the High to increase in pressure?

The radiosonde observations from Glasgow for 1500 GMT January 25 and Omaha for 1500 GMT January 26 (fig. 2), were chosen to illustrate the internal changes in the High during this period. Figure 3 shows how the height (solid lines) and temperature (dotted lines) at the standard-pressure surfaces as well as the thickness (or mean virtual temperature) of the various layers (dashed lines) of the atmosphere changed in the center of the High. The height of all the standard-pressure surfaces rose as the surface pressure in the center of the High increased; the greatest rise was 2,010 feet at 300 mb. and the least 370 feet at 1,000 mb. The temperature rose sharply at all levels in the lower atmosphere up to and including 300 mb.; it fell slightly above this level. The thickness of each layer, which is proportional to the mean virtual temperature and inversely proportional to the density, increased below 300 mb. while the layers from 300–200 mb. and from 200–100 mb. decreased. If z_0 is the height of the 1,000-mb. surface, z_n the height of the 300-mb.

surface, and h the thickness of a layer below 300 mb., these quantities are connected by the relationship [1]:

$$\frac{\delta z_0}{\delta t} = \frac{\delta z_n}{\delta t} - \sum_{i=1}^n \frac{\delta h_i}{\delta t}$$

where t is time and δ refers to differentiation following the moving High center. From this equation it appears that the most effective way to build up a surface High (to increase the value of z_0) would be for the 300-mb. surface (z_n), which was near the tropopause on the 25th, to rise markedly while the thickness of each layer of the troposphere becomes much thinner (colder and more dense). However, what occurred in this case was that the 300-mb. surface rose 2,010 feet in 24 hours while the lower atmosphere warmed sharply; the 850-mb. level was 22° C. warmer on the 26th than on the 25th. The entire contribution to the growth of the surface anticyclone came from the stratosphere. It should be borne in mind that the above discussion refers to changes following a moving system, not to changes at a fixed point. For example, the maximum surface temperature at Omaha was 4° F. less on the 26th than on the 25th even though, as we have seen, temperatures rose in the High on the 26th.

The above result is similar to one obtained by Namias [2] in a study of the abnormal winter 1946–47. In his discussion of the higher surface pressure at Thule, Greenland in February 1947 than in December 1946 he states that “it is clear that the lower 6 km. of the atmosphere contributed very strongly (by 15 mb.) toward making February surface pressures lower than December pressures; it is only at approximately 8 km. that the contributions became positive.” Wexler [3] says “the warm anticyclone must be caused by the ‘piling up’ of air over a given region * * * this process is caused by frictional transport of air southward from the westerlies.” This mechanism may help to explain the development of the High although the upper air data were not examined from this point of view.

As the anticyclone was growing and moving into the central United States, warm, moist air from the tropical Atlantic Ocean and the Gulf of Mexico was advancing from the southwest over the eastern and southeastern United States. On the 26th, Washington, D. C., experienced its highest January temperature of record, 80.2° F., and so did Canton, N. Y., 63.9° F. Before the

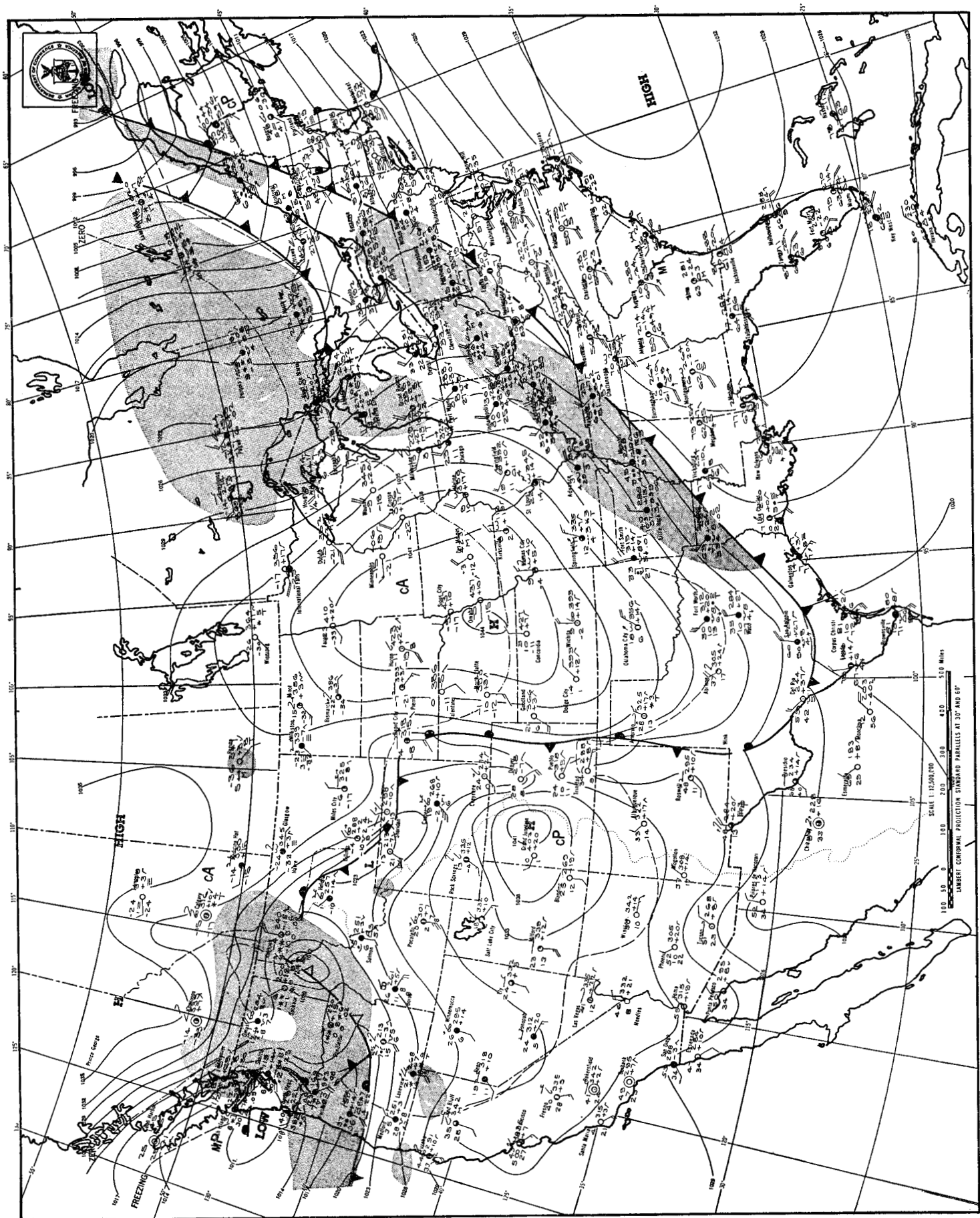


FIGURE 1.—United States surface weather chart for 1830 GMT, January 26, 1950.

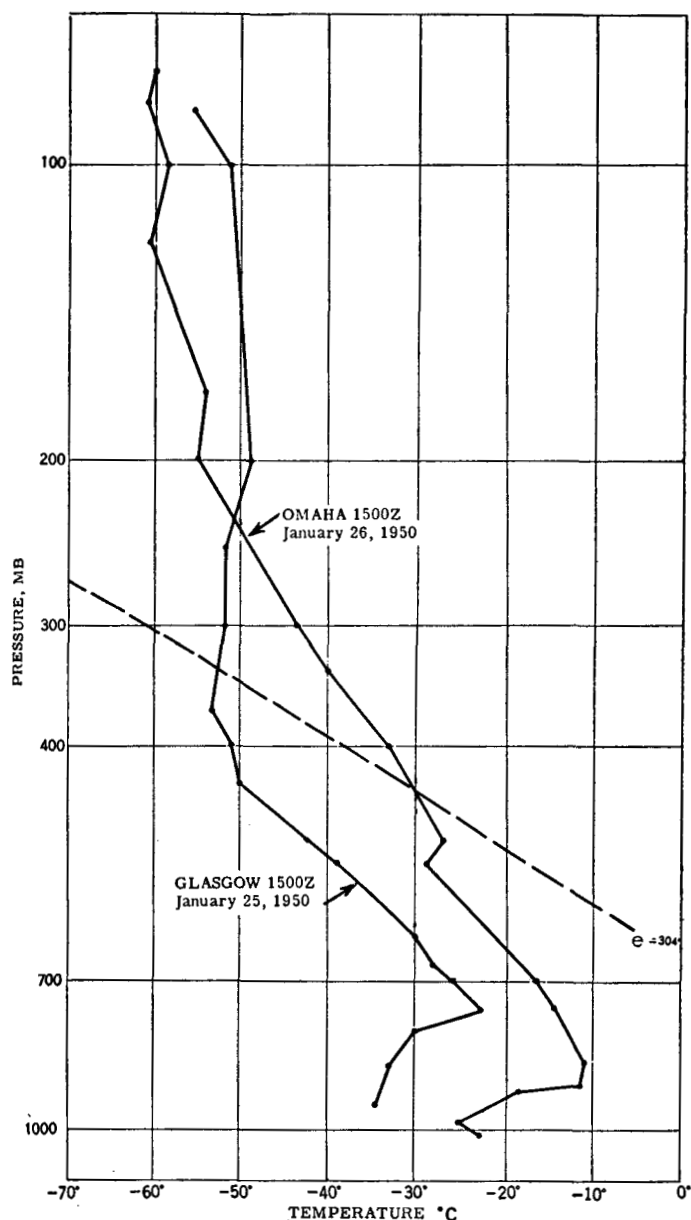


FIGURE 2.—Radiosonde observations from Glasgow, Mont., and Omaha, Nebr.

cold front passed Columbus, Ohio, during the night of January 25, the temperature soared to 74.0° F. This was not only the highest temperature ever recorded in any January at Columbus, but higher than any temperature ever recorded in December or February there. Remarkable surface temperature contrasts were observed on the 26th. On the morning of that day the lowest temperature at Bismarck, N. Dak., was -38° F. while at Little Rock, Ark., the afternoon temperature reached 75° F., a difference of 113° F. during the same day between points 900 miles apart. The weekly anomalies ranged from +21° F. at Asheville, N. C., to -33° F. at Spokane, Wash., for the period ending January 31, 1950, an unusually great contrast in temperature departures for the same week between different points in the United States [4].

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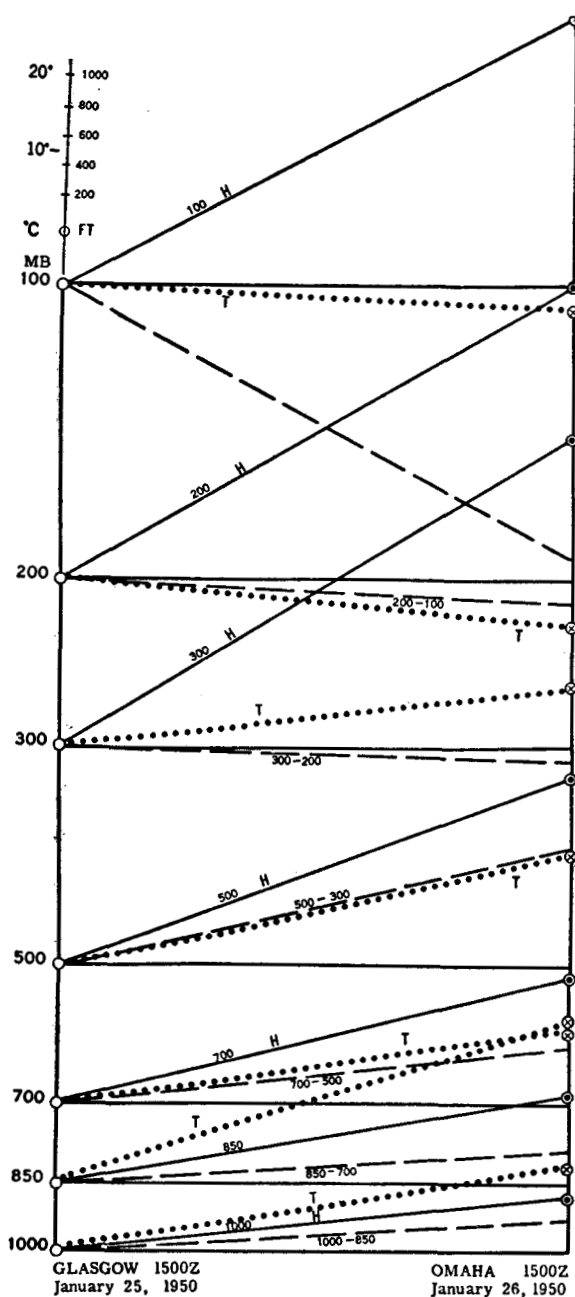


FIGURE 3.—Changes in height (solid lines) and temperature (dotted lines) of standard pressure surfaces, and changes in thickness (dashed lines) of standard pressure layers in the center of the High of January 25 and 26.

Some idea of the intensity of the warm flow may be obtained by reference to figure 1, which shows the tropical maritime air flowing around the west side of the Bermuda High. Another picture of the warm flow is shown in the 700-mb. chart for 1500 GMT, January 26 (fig. 4). Note first the unusually great height of the 700-mb. surface, 10,600 feet, over the southeastern corner of the country; the normal January height of the 700-mb. surface [5] in this region is about 10,150 feet. The temperature at Atlanta, Ga., is 5.5° C. greater than the January normal [6] and this difference increases northward until it reaches 16° C. at Caribou, Maine. The pronounced southwesterly

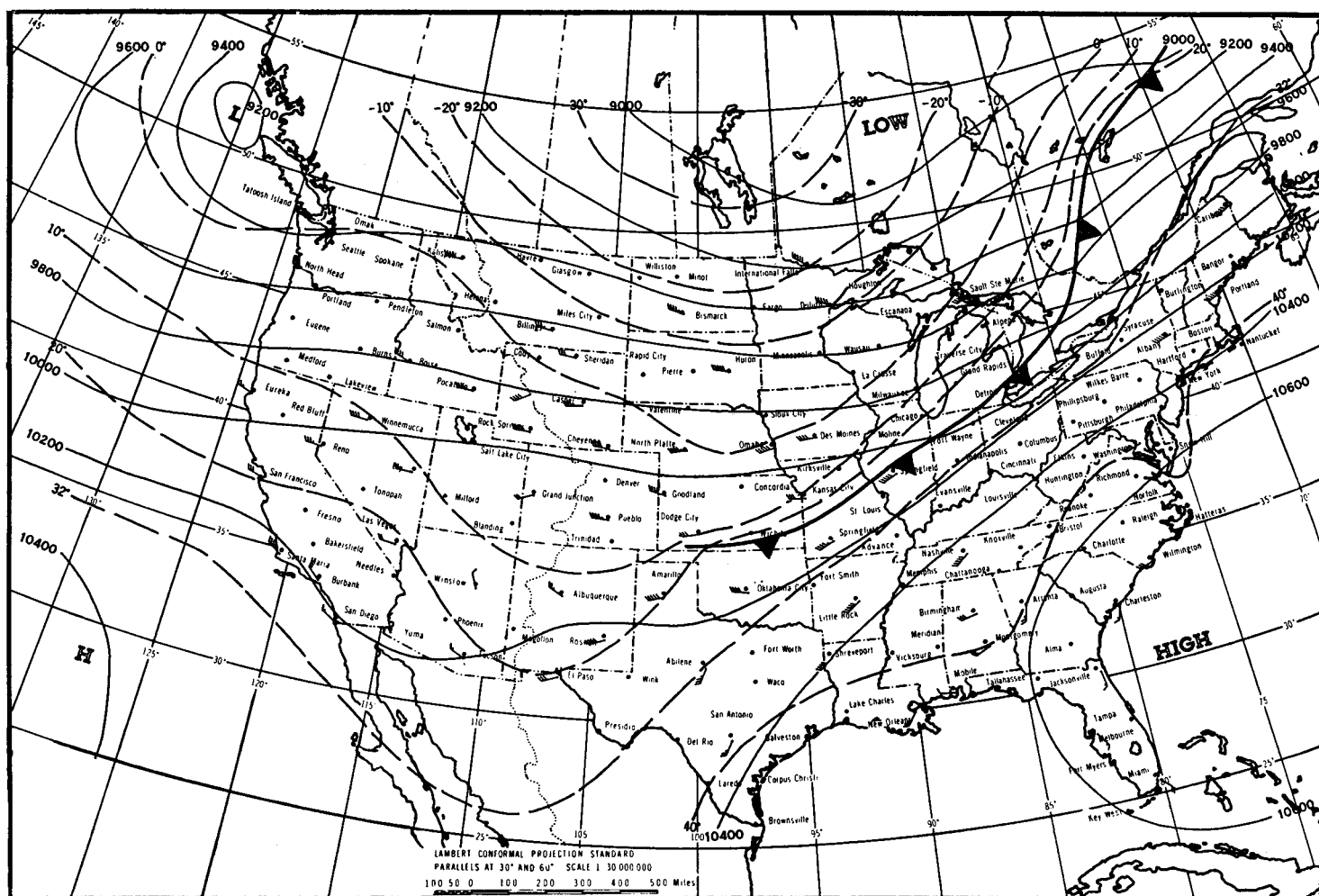


FIGURE 4.—700-mb. chart for 1600 GMT, January 26, 1950. Height is shown in feet, temperature in ° Fahrenheit.

flow in the eastern United States is also in sharp contrast to the normal westerly flow.

Figure 5 reveals the severe cold over the North-Central States on the morning of the 26th. Minima below -30°F . occurred throughout North Dakota and northeast Montana. On the preceding morning Chester, Mont., reported a low of -57°F ., only 9° above the lowest temperature ever recorded in the United States. These remarkably low temperatures occurred when the area was under the influence of the increasing High discussed above. Light winds, clear skies, snow cover, and a dry atmosphere favored the loss of large amounts of heat from the surface. The 700-mb. chart (fig. 4) shows that the unusual cold was not restricted to a shallow ground layer. The temperatures in the North Central States were 10° to 15°C . lower than the normal 700-mb. temperatures, and the reason for this is to be found in the northerly trajectory of the air.

Both the surface and 700-mb. charts (figs. 1 and 4) show a Low just off the northwest tip of the State of Washington. This was a persistent feature of these charts throughout the month. In the synoptic-chart classification of the

Meteorology Department of the California Institute of Technology [7] the situation of January 26 would be referred to as type D. In contrast to January 1950, the abnormal January 1949 was characterized by a type A pressure pattern [8].

Type D in winter is characterized by a large crescent-shaped polar High which extends from northwestern Canada west through Alaska, south through the Aleutian Islands and southwest through the Pacific. A major storm develops off the coast of Washington and persists during the period with apparently a new front developing each day. * * * As the two major troughs move eastward across the United States each is followed by a polar outbreak. Rainfall along the west coast is continuous with heavy amounts accumulating [7].

The usual 700-mb. pattern with type D is one with a trough 300 to 500 miles off the west coast of the United States with northwest winds to the rear of the trough and west winds in advance [9]. The reason for the formation of the low pressure area off the west coast of the continent appears to be closely related to the heating of the very cold Arctic air, which comes from northern Asia or the frozen Arctic Sea, by the relatively warm water of the

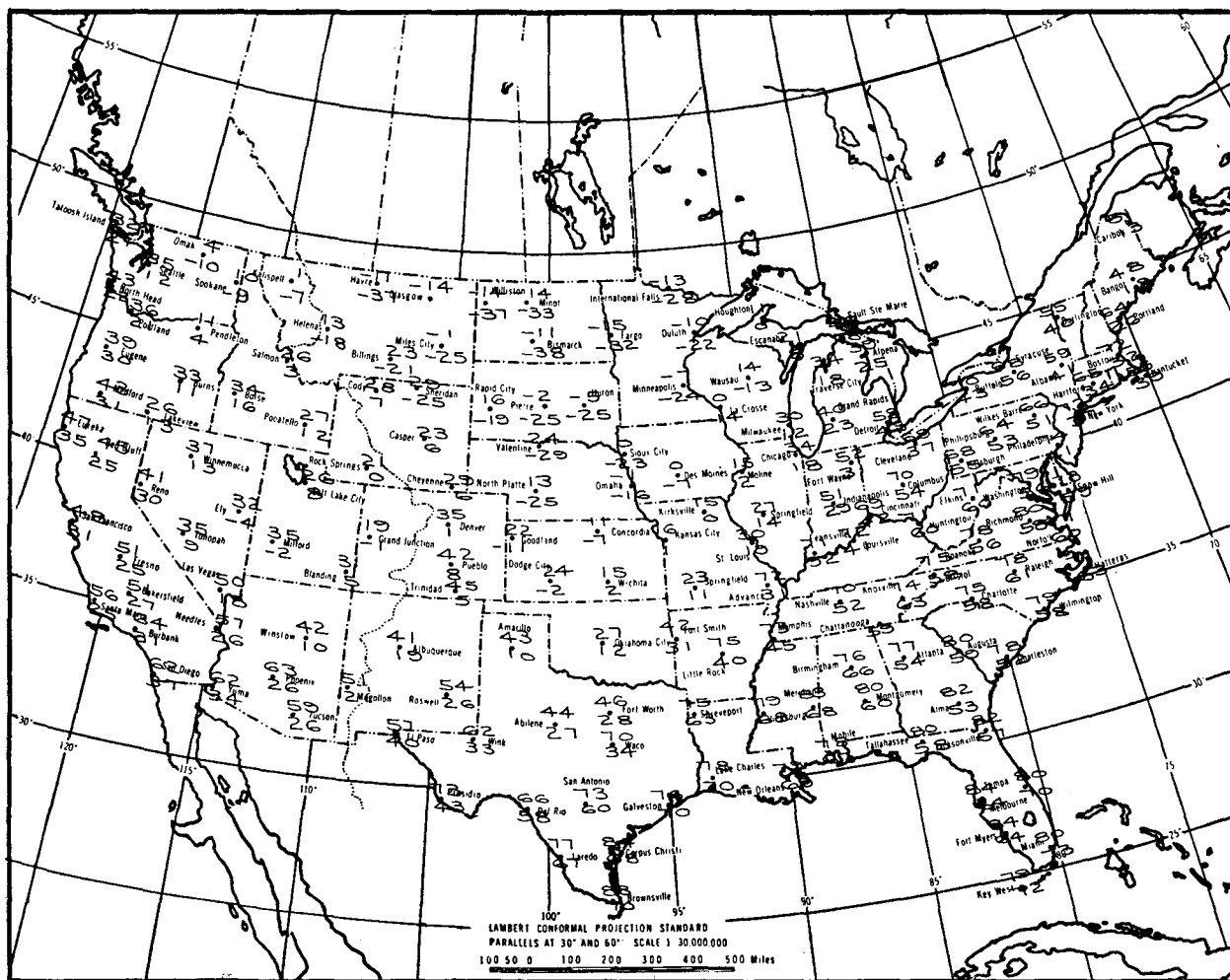


FIGURE 5.—Maximum (top number) and minimum (bottom number) temperatures for January 26, 1950.

North Pacific Ocean. This Low may also be thought of as the eastern lobe of a split Aleutian Low, the western portion of which may be located near the Kamchatka Peninsula.

During the 26th more than an inch of precipitation fell in an oval-shaped area whose longer axis stretched from near Vicksburg, Miss., to Columbus, Ohio, and whose shorter axis ran from near Advance, Mo., to Nashville, Tenn. As the cold front moved eastward that day rain or snow fell all the way from Maine to Texas. The heavy precipitation of the 26th fell just in advance of the 700-mb. trough, in fairly good agreement with the winter precipitation pattern outlined by Klein [10]. The cause of the heavy precipitation was the lifting of the convectively unstable Gulf air (see the Lake Charles sounding for 1500 GMT, January 26 (not reproduced)), from the southwest over the cold northeasterly current at the ground behind the cold front. The instability of the warm air was further revealed in the occurrence of thunderstorms all the way from southeastern Texas to Ohio as the cold front passed these regions.

This meteorological situation repeated itself several times during the month, e. g., on the 6th, 11th, 14th, 16th, 19th, and 31st, with the result that 300 percent to 400 percent of the normal January precipitation [11] fell in a band about 200 miles wide extending approximately from Memphis to Toledo. It may be of interest to compare the weather of January 6 (fig. 6) with that of January 26.

Note that in both cases the Bermuda High is well developed and is bringing a south-to-southwest flow of tropical air over a large part of the eastern United States. The location and intensity of the eastern frontal system, the Plateau High, and the cyclone off the northwest coast of Washington on the 6th agree quite well with the corresponding features of the surface map of the 26th. The chief features of the 700-mb. chart for 1500 GMT, January 26, are found in the 700-mb. chart for 1500 GMT of the 6th (not reproduced). As might be expected, heavy to moderate rains fell in the Ohio and lower Mississippi Valleys on the 6th. Precipitation was heavier on this date in most of Ohio, Pennsylvania, and New York

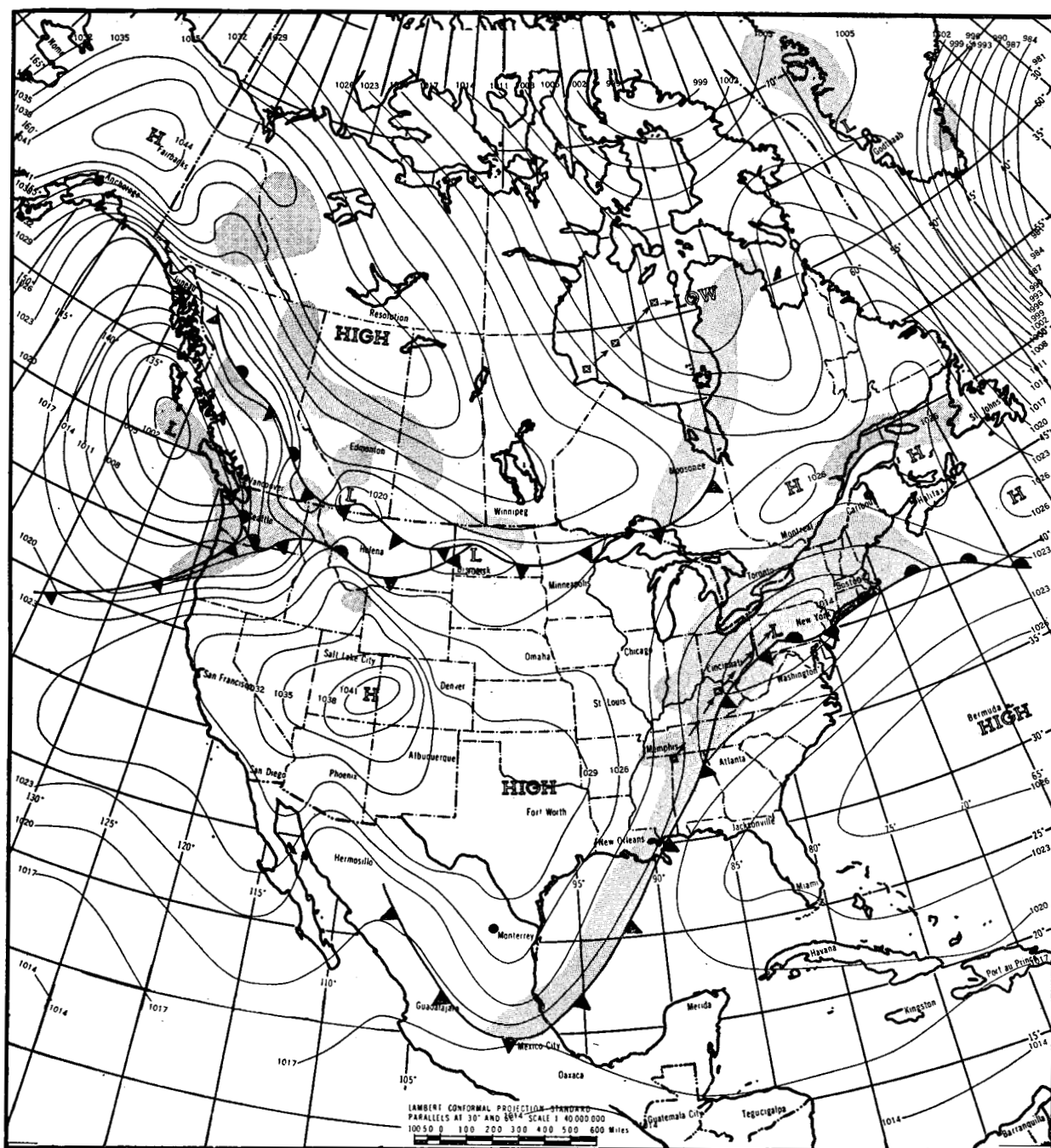


FIGURE 6.—North American surface weather chart for 1830 GMT, January 6, 1950.

because of the more pronounced cyclonic activity there than on the 26th. A record 24-hour snowfall of 16 inches fell in Spokane, Wash., during the 6th and 7th from the warmer polar Pacific air overrunning shallow, cold continental air. The location of the frontal system and the interaction of the different air masses associated with the

persistent off-shore cyclone appear to explain adequately the heavy snowfall.

Temperature extremes also occurred on the 6th; Philadelphia, Pa., reported a maximum of 71° F. that afternoon, while a minimum of 17° F. was reported at Tucson, Ariz., and of 11° F. in the Yuma area.

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